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DEMONSTRATE THE EFFECTIVENESS OF IODINE FOR THE DISINFECTION OF PUBLIC WATER SUPPLIES AND DETERMINE THE PHYSIOLOGICAL EFFECTS ON A HUMAN POPULATION

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PB 216 450

Third Progress Report

of

A Demonstration Project Grant

from

The Division of Water Supply and Pollution Control

Public Health Service

WPD-19-03-65

Object

"To demonstrate the effectiveness of iodine for the disinfection of public water supplies and to determine the physiological effects on a human population."

Dr. A. P. Black, Project Director
and
Research Professor of Chemistry and
Sanitary Science, University of Florida
Gainesville, Florida

Period covered Feb. 1, 1963 through Oct. 31, 1965

Oct. 31, 1965

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2. Summary Statement.

The water supplies of three state institutions serving approximately 800 individuals and convenient to the University of Florida have been continuously iodinated for a period of more than two years under the most careful chemical, bacteriological and physiological controls. The accurate feeding of iodine to a water supply has been found to be a simple procedure. No difficulties have been encountered in continuously feeding the element in saturated solution to provide any desired dosage with an overall accuracy of ± 0.05 ppm. Iodine has been found to be extremely effective as a disinfecting agent. Of more than 1000 samples collected from the two systems for bacteriological analysis, only about 2% were unsatisfactory, whereas by PHS Drinking Water Standards, 15% of unsatisfactory samples is permissable. One of each of four inmates was selected for medical and physiological tests, a total of 149 subjects. There is no evidence to date that iodine under our experimental conditions has any detrimental effect on general health or thyroid function. No allergic reactions to iodine have been found, no change in the physical examination or size of the thyroid gland. The studies indicate that iodine is fully as effective as chlorine for the disinfection of public water supplies and that it possesses a number of advantages over chlorine when used for that purpose.

3. Concise Statement of Progress

(a) Activities and accomplishments - The water in two water systems supplying three Florida correctional institutions and serving a total of approximately 800 individuals has been continuously disinfected with iodine for more than two years under carefully planned chemical, bacteriological and medical controls. To date, 70 million gallons of water has been iodinated.

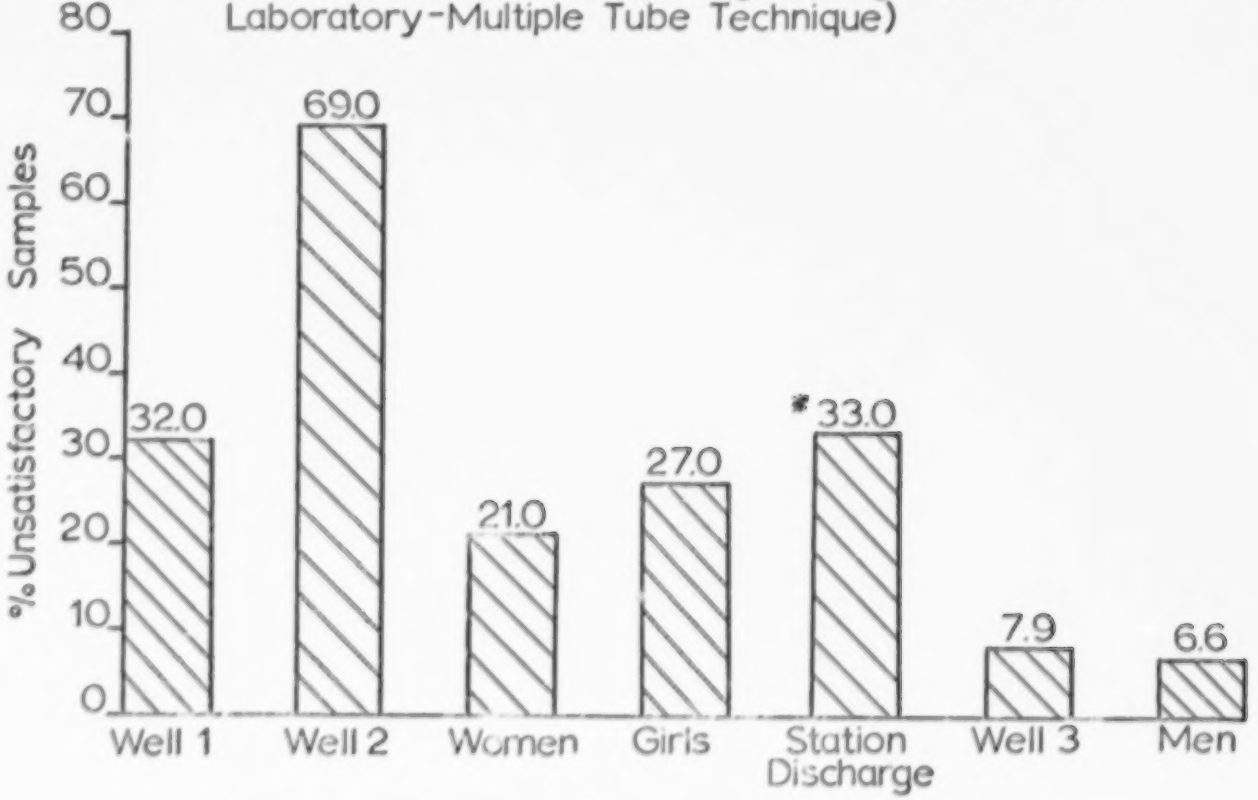
The physical and chemical properties of iodine make it particularly suitable for use as a water disinfectant. Since its vapor pressure is only 0.31 mm of Hg at room temperature, it may be stored indefinitely in non-metallic containers and at atmospheric pressure without appreciable loss or deterioration. Although its water solubility is not high, its saturated solution is sufficiently concentrated for feeding purposes. Its low chemical reactivity, least of all the halogens, means that lower residuals are more stable and therefore persist longer in the presence of organic or other oxidizable material, and the possibility of the production of tastes and odors by such reactions is minimized. The feeding of elemental iodine to water is a very simple procedure. No difficulties have been encountered in continuously feeding the element in saturated water solution to provide any desired dosage with an overall accuracy of plus or minus .05 ppm.

Iodine has been shown to be extremely effective for the disinfection of two public water supplies. Of more than 1000 samples collected from the two systems for bacteriological analysis, only about 2% were unsatisfactory, far lower than the 15% permissable by the 1962 DRINKING WATER STANDARDS. See Figures 1, 2, and 3. Disinfection was begun with a dosage of 1.0 ppm, lowered stepwise to 0.3 ppm and again raised to 1 ppm.

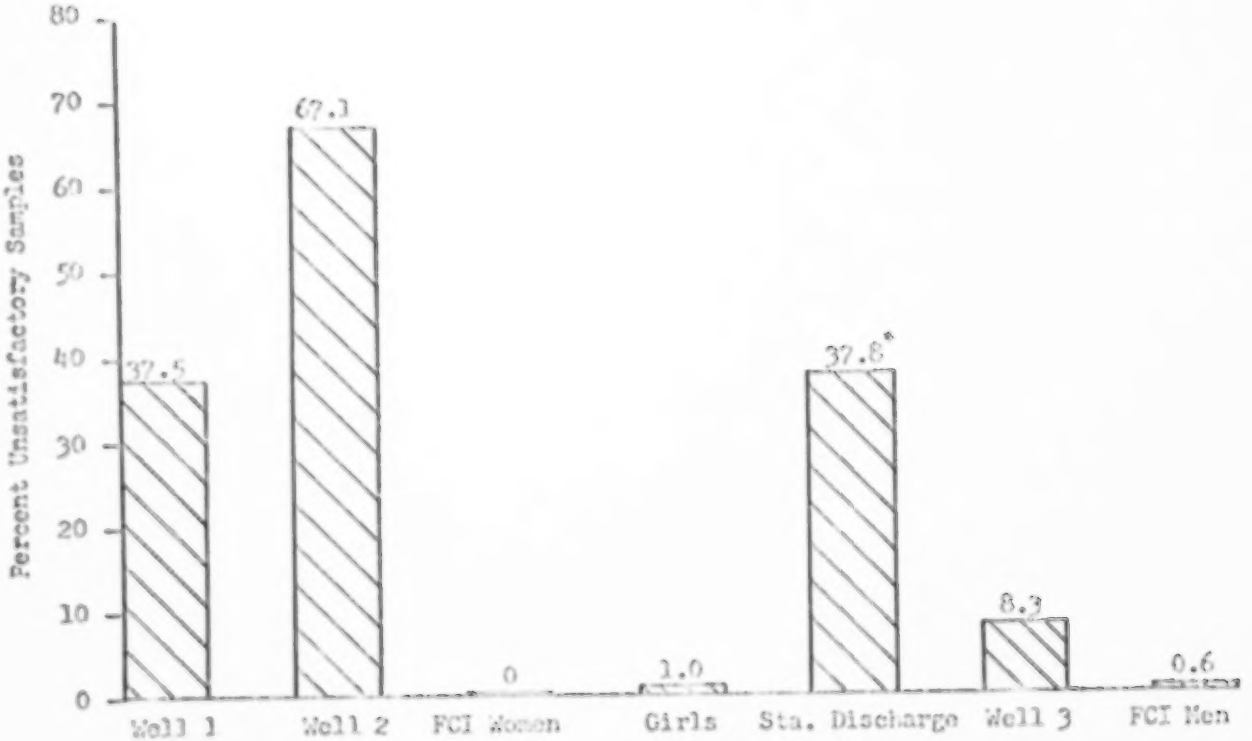
One of each of four inmates in the three institutions, a total of 149 subjects, were selected for medical and physiological tests. The group included 45 adult white males, 70 white and colored adult females, and 34 colored girls. The series was completed by 67 subjects. Medical studies included the assessment of the three indices of thyroid function, namely, radioactive iodine uptake (RAI), protein bound iodine (PBI), and butanol extractable iodine (serum thyroxine) BEI, and a study of urinary iodine excretion. Each subject received the series of tests twice before iodine feed was begun and 30 days apart, following which the tests were made on all subjects one, three, seven and ten months after beginning the feed of iodine. Determinations were also made of the ratio of urinary iodide to creatinine excreted in each of 50 inmates. As might be expected the RAI intake dropped from about 17% at the beginning of the study to about 2% at the end. See Figure 4. Values for PBI increased somewhat but the mean for the group was still within the range of values foundin normal individuals. See Figure 5. No significant change in the mean value for BEI was found. See Figure 6. There has been no apparent change in the physical examination, specifically no change in the size of the thyroid gland. No allergic reactions attributable to iodine have been found. There is no evidence to date that iodine under our experimental conditions has any detrimental effect on general health or thyroid function.

Bacteriological Data during period of disinfection with calcium hypochlorite Feb.-Oct. 1963.

(Earle B. Phelps Sanitary Engineering Research Laboratory-Multiple Tube Technique)

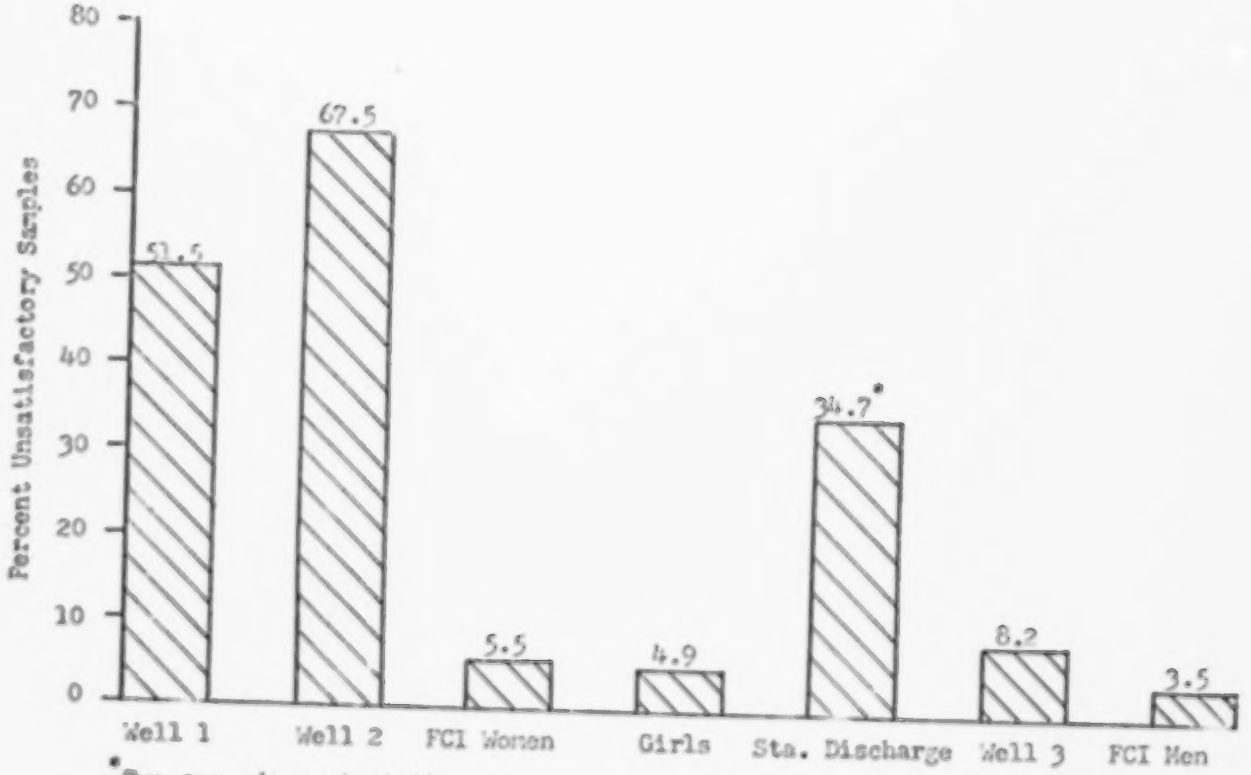


*20 hours contact time.



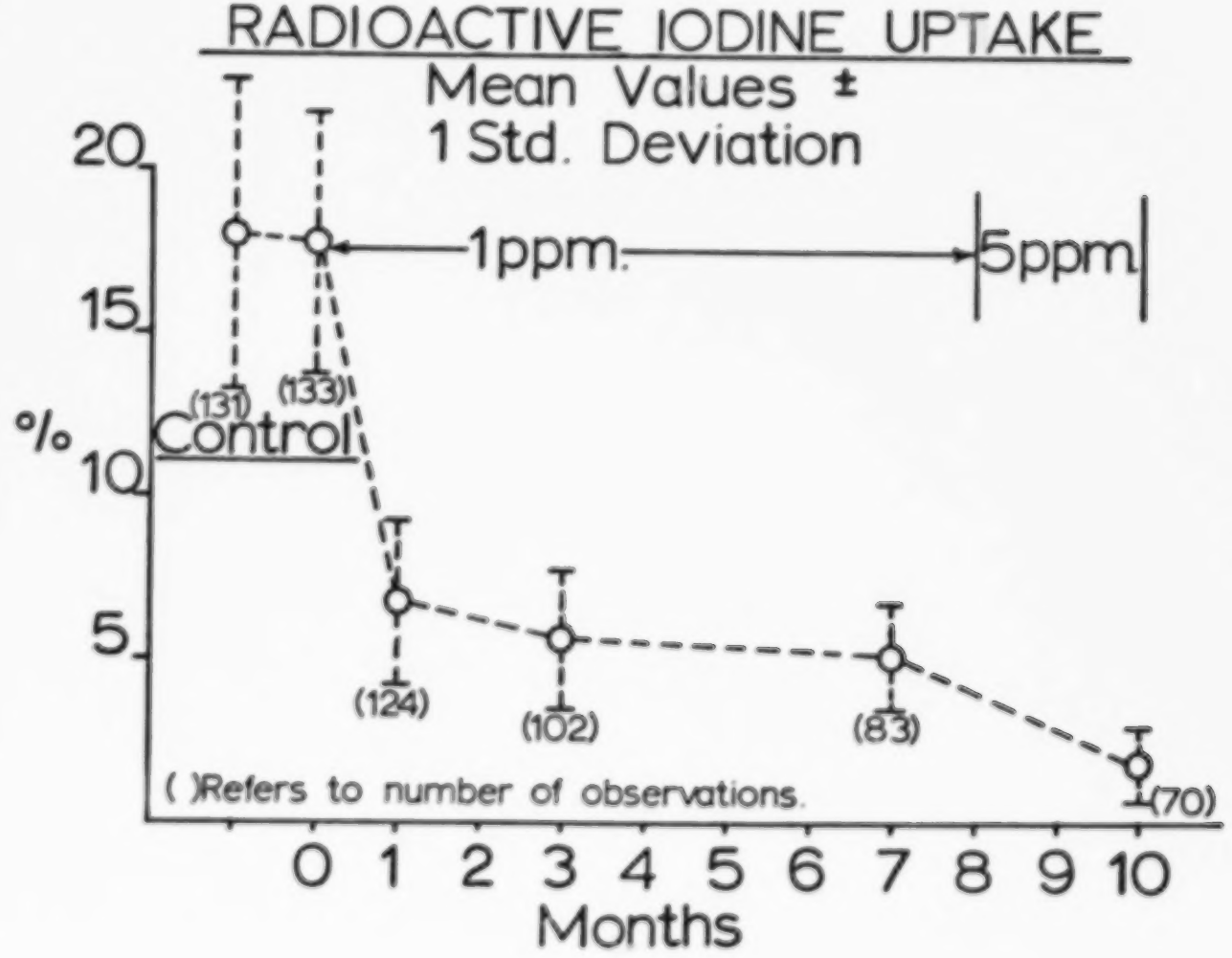
*Two seconds contact time.

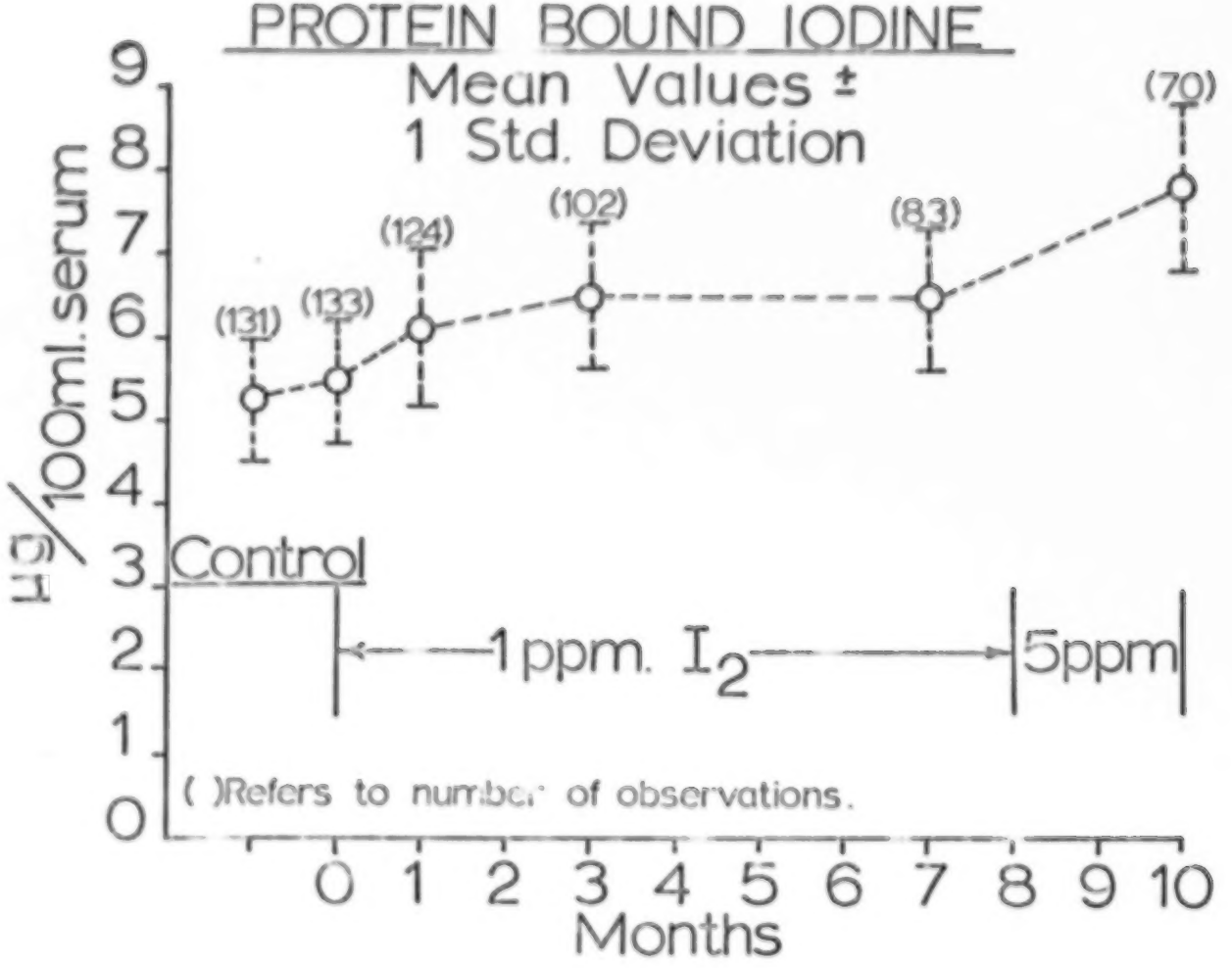
- Bacteriological Data During 22 Months of Iodination, October 28, 1963 to September 1965. (Earle B. Phelps Sanitary Engineering Research Laboratory, Multiple Tube Technique).

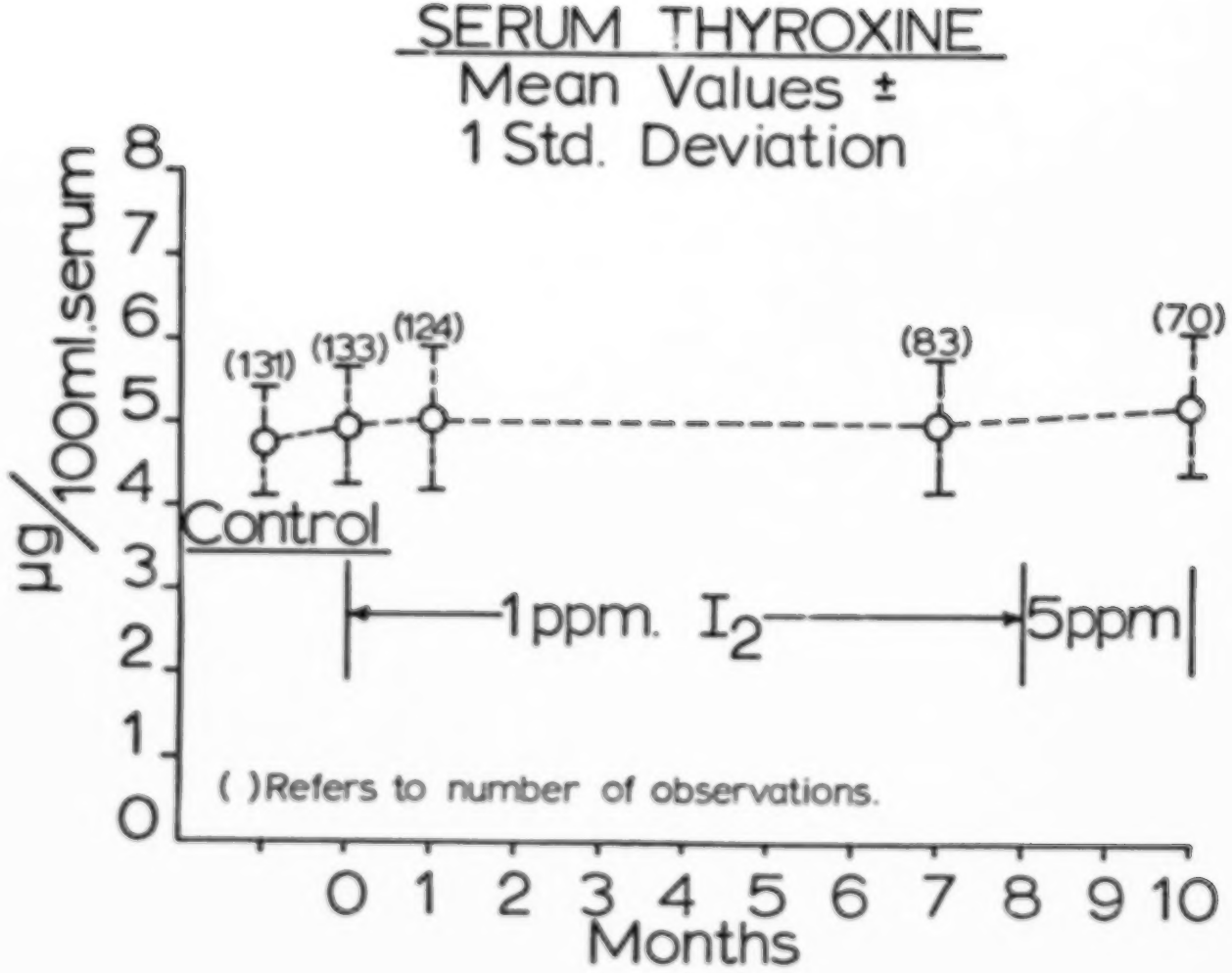


*Two seconds contact time.

- Bacteriological Data During 22 Months of Iodination, October 28, 1963 to September, 1965. (Florida State Board of Health, Membrane Filter Technique).


RADIOACTIVE IODINE UPTAKE
Mean Values ±
1 Std. Deviation
20
15
%
10
5
1ppm.
5ppm.
(131)
(133)
Control
(124)
(102)
(83)
(70)
( )Refers to number of observations.
0 1 2 3 4 5 6 7 8 9 10
Months


PROTEIN BOUND IODINE
Mean Values ±
1 Std. Deviation
µg/100ml. serum
(131)
(133)
(124)
(102)
(83)
(70)
Control
1ppm. I_2
5ppm
( )Refers to number of observations.
Months


SERUM THYROXINE
Mean Values ±
1 Std. Deviation
µg/100ml.serum
8
7
6
5
4
3
2
1
0
(131)
(133)
(124)
(83)
(70)
Control
1ppm. I_2
5ppm
( )Refers to number of observations.
0 1 2 3 4 5 6 7 8 9 10
Months

In dosages up to 1.0 ppm iodine produces no discernible color, taste or odor in water.

The relatively high cost of iodine compared to chlorine is off-set by three important considerations. First, its low chemical reactivity is shown to result in low iodine demands even in the presence of gross pollution. Second, under actual conditions of use, little or no iodine is lost by iodate formation. Last, but most important, the ease with which the iodide ion may be reoxidized makes it possible to maintain disinfecting residuals to the furthest extremeties of the distribution system by a choice of the proper oxidizing agent.

A swimming pool study was made to investigate the possibility that iodine may be absorbed by the skin of individuals exposed to water containing it. Twenty-two subjects received the same series of tests as those used at Lowell before and after swimming throughout a period of one month in pool water disinfected with iodine. Average values for group for RAI, PBI, and BEI were not significantly changed and no evidence of allergy or change in size of the thyroid gland was detected in any subject during the study.

A new, rapid, sensitive, accurate colorimetric test for determining iodine residuals in water has been developed and extensively used during these studies. Its accuracy has been found to be substantially higher than that specified by the National Sanitation Foundation. Perhaps even more important, it has been found that it may be used to determine <u>free</u> chlorine residuals at pool water temperature without interference by combined chlorine, practically always present. It is thus far superior to orthotolidine, the reagent now commonly employed.

Studies in progress or planned include:

(a) Additional medical studies of iodine physiology. Although all of the girls and almost all of the men in the original group selected for study have been discharged, practically all of the women are still available since they are confined either for life or for long terms in a maximum security prison. Each additional year of exposure to iodine provides data of increasingly greater significance. At least two series of medical tests per year are planned, not only for all of the women remaining but also on new groups of men and children.

(b) Effect of water pH on bacteriology, on the persistence of iodine residuals and on the rate of iodate formation, if any. Caustic soda will be used to raise pH stepwise from the present 7.4 to about 9.5, using polyphosphate to prevent scale formation in the distribution system. All equipment and instrumentation for this extended test has been installed and it will be begun in late November of 1965. The data to be accumulated during this study are a necessary prerequisite for initiating iodine feed into a water distribution system of major size.

(c) Comparison of log reduction curves of equal concentrations of chlorine and iodine on standardized suspensions of selected organisms. These studies have been in progress for some time but will be continued and expanded in scope. They are yielding data of greatest interest and value and have already indicated the necessity for complete review and reinterpretation of current published data.

(d) Studies of the relative chlorine and iodine demands of water containing many types of organic compounds, pesticides, surfactants and other types of domestic and industrial pollutants. These studies have been under way for some months but much work remains to be done.

(e) Corrosion studies with aqueous solutions of iodine.

(f) Studies of the slow, controlled reoxidation of the iodide ion to elemental iodine. It is the ease with which the iodide can be oxidized to elemental iodine that offers the greatest potential toward its economical use for disinfecting public water supplies. No ideal oxidizing agent has as yet been found and a search for such an agent continues.

(g) Bacteriological studies to identify the organisms which are present when high plate counts are found in swimming pool water from samples negative to both E. coli and S. faecalis. Little is known as to the nature of these organisms and much work is needed in this area.

(h) Expansion of our work with swimming pools to include the newly rebuilt olympic size pool of the University of Florida, the faculty club pool and the Gainesville municipal pool.

These studies indicate that iodine is fully as effective as chlorine for the disinfection of public water supplies and that is possesses a number of advantages over chlorine when used for that purpose.

(b) Significant problems and major deviations from approved plan - There have been very few troublesome problems encountered during the two years and nine months covered by this progress report. A few will be briefly mentioned.

1. More time was needed for preparatory work and reconditioning of the two water systems than had been anticipated. It was necessary to almost completely rebuild the larger pump house, add a new roof, pavement and drainage area, recondition the pumps and install a large amount of new equipment. This work was done at relatively low cost through the cooperation of the prison administration in supplying at no cost thousands of man-hours of prisoner labor. All engineering and design work was done by Riley N. Kinman, project engineer-chemist, who is a registered professional engineer.

2. It had been anticipated that a difficult public relations problem would develop, among both the prison inmates and the civilian employees. Due to the excellent cooperation and understanding of the prison administration these problems did not develop, and during the entire

course of the work to date, not a single troublesome incident involving personnel has occurred.

3. The original study plan envisioned additional work employing a grossly polluted water supply. While water from one of the three wells used in the prison study was bacteriologically unsatisfactory more than 50% of the time, the other two showed occasional evidence of pollution, it was felt that to evaluate the full potential of iodine as a water disinfectant it should be studied under the most extreme conditions. During the second year of the study, early in 1964, the treated water of the city of Gainesville began to exhibit the presence of objectionable levels of organic color and the presence of blankets of detergent foam several feet high in the recarbonation basins of the water treatment plant afforded unmistakable evidence of the presence of treated sewage in the water plant effluent. The geology of the Gainesville area is characterized by porous, even cavernous limestone aquifers and the presence of hundreds of sink holes which recharge these formations with surface drainage. The treated effluent from the sewage treatment plants of both the University of Florida and the city itself finally finds its way into these aquifers. Concurrent with this evidence of deterioration of treated water quality, the widespread incidence of intestinal disturbances throughout both the city and the university was noted and was the subject of study and investigations by national, regional, and state health authorities. The method of water treatment is softening with lime and soda ash followed by recarbonation for pH adjustment. Due to the presence of water main deposits throughout the older portions of the system resulting from the use of untreated water for many years, a free chlorine residual cannot be maintained due to the immediate production of tastes and odors so pronounced that a flood of consumer complaints results whenever it has been tried.

Disinfection consists of the addition of a high dosage of chlorine, approximately 10 ppm, in the softening unit, where the pH value is 10.4 - 10.5. This oxidizes the H_2S present in the raw water but, due to the high pH in the unit the remaining chlorine is largely present as hypochlorite ion of relatively low disinfecting power. After the water is recarbonated to lower the pH to about 9.0 ammonia gas is fed to the water on top of the filters and a chloramine residual of about 2 ppm carried through the filters and into the distribution system. Both long experience and published data have indicated that the disinfecting power of a chloramine residual is only about one-thirtieth that of free chlorine.

This situation provides an ideal opportunity to maintain a powerful disinfecting residual to the furthermost ends of the system by feeding a soluble iodide and releasing and re-releasing it as elemental iodine, and thus extending by many hours and even by days the period during which bactericidal and viricidal activity can take place. Such a procedure has received the unanimous approval of the Florida State Board of Health and the informal approval by the City Commission of the city of Gainesville and formal approval will follow at its next meeting.

This provides an ideal opportunity to study elemental iodine under conditions of actual use in a water system of major size serving a city of 50,000 people, and adds many new and important objectives to be attained. Accordingly, a three-year extension of the original grant is being sought during which the prison studies will be continued to provide exposure data covering more than five years, and the new Gainesville studies initiated and carried forward.

(c) Report on project staff - For the period Feb. 1, 1963 through Oct. 31, 1965.

Professional	1st yr.	2nd yr.	3rd yr.
A. P. Black, Research Professor of Chemistry and Sanitary Science	50%	50%	50%
W. C. Thomas, Jr., Acting Head, Department of Medicine	5%	5%	5%
Gerhard Freund, Assistant Professor of Medicine	50%	50%	50%
R. P. Vogh, Engineering Consultant, part-time	5%	5%	5%
R. N. Kinman, Research Associate, Department of Chemistry and Sanitary Science	100%	100%	100%
Technical Nonprofessional			
Margaret E. Whittle (Chemist)	100%	100%	100%
Pauline Gubbins (Bacteriologist)	--	100%	100%
Charles Glover (Medical Technician)	50%	50%	--
Laboratory Assistants			
Charles Reif, part-time	Hourly basis		
William Potter, part-time	Hourly basis		

(d) Presentation of papers, publications and degrees awarded.

Papers presented:

1. "The Chemistry, Technology and Physiology of Iodine in Water Disinfection." 29th Annual Educational Conference, National Association of Sanitarians, Miami Beach, Florida, June, 1965, A. P. Black, R. N. Kinman, W. C. Thomas, Jr., Gerhard Freund and E. D. Bird.

2. "Iodine for Water Disinfection." Annual Conference Southeastern Region, National Association of Soft Water Service Operators, Gainesville, Florida, October 1965. A. P. Black and R. N. Kinman.

3. "Iodine for Water Disinfection." Joint annual meeting, Florida Section AWWA and Florida Section, Water Pollution Control Federation, Jacksonville, Florida, November 1965. A. P. Black and R. N. Kinman.

Presentations scheduled:

4. "Iodine for the Disinfection of Swimming Pool Water." Annual Meeting, National Swimming Pool Institute, Houston, Texas, January 1966. A. P. Black and R. N. Kinman. Formal paper and panel discussion.

Papers published:

1. "The Use of Iodine for Water Disinfection." A. P. Black, R. N. Kinman, W. C. Thomas, Jr., Gerhard Freund, and E. D. Bird. Jour. AWWA. In press; scheduled for November 1965 number.

2. "Effect of Iodinated Water on Thyroid Function." G. Freund, E. D. Bird, W. C. Thomas, Jr., R. N. Kinman and A. P. Black. Jour. Clinical Endocrinology and Thyroid Metabolism. In press.

3. "The Disinfection of Swimming Pool Water with Iodine" (by invitation). Swimming Pool Age, January 1966. A. P. Black, R. N. Kinman and G. P. Whittle.

Graduate degrees awarded:

1. G. P. Whittle, M.S., August 1964. Title of thesis: "A New Colorimetric Method for Determining Iodine Residuals in Water."

2. R. N. Kinman. To receive Ph.D. December 1965. Title of dissertation: "The Disinfection of Public Water Supplies with Elemental Iodine."

A. P. Black

Biographical Sketch

BLACK, ALVIN PERCY: Research Professor of Chemistry and Sanitary Science, University of Florida, and President, Black, Crow and Eidsness, Inc., Engineers, 700 SE Third Street, Gainesville, Florida.

PERSONAL RECORD: Born August 30, 1895 in Blossom, Texas; married, two children; height 6°4", weight 185 lbs. Health, excellent.

SCHOLASTIC TRAINING:

1917	A.B. cum laude	Southwestern University (Georgetown, Texas)
1922-23		Iowa State College
1925-26		Harvard University
1933	Ph.D.	University of Iowa

EXPERIENCE:

1917-18 Wesley College (Texas) Professor and Head of Department of Chemistry.
1918 U. S. Army, Chemical Warfare Service.
1918-19 U. S. Bureau of Standards, Assistant Chemist.
1919-23 U. of Fla., Asst. Prof. Chem. Engineering
1923-41 U. of Fla., Prof. of Ag. Chem.
1941 U. of Fla., Professor.
1942 Registered Engineer, State of Florida.
1947 Black and Associates, Inc., Engineers, President and Chairman of the Board. Now Black, Crow and Eidsness, Inc., Engineers.
1949-56 U. of Fla., Head, Dept. of Chemistry.
1956 U. of Fla., Research Professor

SOCIETIES AND ORGANIZATIONS:

Professional:

American Chemical Society. Chairman, Div. of Water, Sewage and San. Chem., 1937-8. Chairman, Councilor and Secretary, Fla. Section, 1938-39.

American Water Works Association. National Director, 1936-39. National Vice President, 1948-49, National President, 1949-50.

Southern Association of Science and Industry. Vice President, 1953. President, 1954.

Southern Regional Education Board. Chairman, Study Commission on Chem. and Chem. Eng., 1954-56.

Journal of Chemical Education. Associate Editor, 1924-40.

Water Works Engineering. Member of Editorial Board, 1950-64.

The Municipal South. Member of Editorial Board, 1953 - . Editor of monthly column, 1957 - .

The Sanitarian. Member of Editorial Board, 1953 - .

College of Electors of The Hall of Fame for Great Americans, New York University. Member, 1955 - .

National Advisory Dental Research Council, USPHS. Member 1951-55.

Office of Saline Water, U.S. Dept. of Interior. Consultant, 1952-59.

Florida Public Health Association. President, 1944.

Florida Academy of Sciences, Florida Engineering Society, National Society of Professional Engineers, Consulting Engineers Council, Newcomen Society of North America, Soil Science Society of Florida.

Honorary: Alpha Chi Sigma, Alpha Epsilon Delta, Alpha Zeta, Phi Kappa Phi, Sigma Tau, Sigma Xi, Gamma Sigma Epsilon, Tau Beta Pi, Florida Blue Key.

AWARDS, CITATIONS, AND BIOGRAPHICAL MANUALS:

National Awards: Fuller Award, American Water Works Assn., 1939.

Goodell Prize, American Water Works Assn., 1949.

Diven Medal, American Water Works Assn., 1954.

Honorary Membership, American Water Works Assn., 1956.

Ralph Lloyd Jones Award, National Assn. of Soft Water Service Operators, 1956.

Water Purification Division Award, American Water Works Assn., 1959.

Biographical Manuals: Who's Who in America, American Men of Science, Who's Who in Engineering, Who Knows and What, Who's Who in American Education, Chemical Who's Who, Who's Who in the South and Southwest.

FIELDS OF INTEREST: Water Chemistry and Treatment. Basic Mechanisms of Water Coagulation. Applications of Microelectrophoretic Techniques to Coagulation Studies. Studies of Effectiveness of Polyelectrolyte Coagulant Aids. Studies on Mutual Coagulation. Activity of Silica Sols. Nature of Organic Color in Water. Methods for Removal of Fluorides from Water. Effectiveness of Polyelectrolyte Coagulant Aids for the Removal of Radioactive Isotopes by Water Treatment Processes. Effectiveness of Iodine for Water Disinfection. Analytical Methods for the Determination of Several Ions in Water.

Consultant to numerous municipalities and industries on problems of water supply and treatment.

PUBLICATIONS: Author of 110 papers in the above areas.

A. P. BLACK PUBLICATIONS (Since August, 1933)

1. Formation of Floc by Ferric Coagulants. Ind. Eng. Chem., 25, 898-902 (1933).
2. Coagulation with Iron Compounds. Jour. A.W.W.A., 26, 1713-1718 (1934).
3. Formation of Floc by Ferric Coagulants. Proc. Am. Soc. Civ. Eng., 59, 1539-42 (193
4. Formation of Floc by Aluminum Sulfate. Ind. Eng. Chem., 25, 811 (1933).
5. Oleoresin from Individual Trees of Slash and Long Leaf Pine. Ind. Eng. Chem., 26, 66 (1937).
6. Fluorine in Florida Waters. Proc. Fla. Soc. A.W.W.A. 10, 5 (1939).
7. Coagulation as Applied to Industrial Waters. Jour. A. W.W.A., 29, 1533-47 (1937).
8. New Supply for Ft. Myers, Florida. Wtr. Wks. Eng., April 27, 1938.
9. New Water Softening Plant at Daytona Beach, Florida. The American City, April, 19
10. The Determination of the Hydrogen Ion Activity and Buffer Capacity of Natural and Treated Waters. Ind. Eng. Chem. (Analytical Ed.), 11, 261-264 (1939).
11. St. Augustine Completes New Softening Plant. Public Works, May, 1938.
12. Reforming Florida's Waters. Wtr. Wks. Eng., June, 1939.
13. Water Purification, A Major Florida Industry. Fla. Municipal Record, April, 1940.
14. The Preparation of Methyl Nitrate. Organic Syntheses, Vol. XIX, (1939).
15. The Preparation of Phenylnitromethane. Organic Syntheses, Vol. XIX, (1939).
16. Methods of Determining Fluorides: Committee Report. Jour. A.W.W.A., 33, 1965-2017 (1941).
17. Water Conservation in Florida. Part I. Economic Leaflets, Vol. 5, No. 2, Jan. 1946 (U. of Fla. publication).
18. Water Conservation in Florida. Part II. Economic Leaflets, Vol. 5, No. 3, Feb. 1946. (U. of Fla. publication).
19. Basic Concepts in Ground Water Law. Jour. A.W.W.A., 22, 989-1002 (1947).
20. Soil and Water Conservation in Pinellas County. Economic Leaflets, Vol. 6, No. 2, Jan. 1947.
21. The Chemistry of Water Treatment. (Condensed from lectures given at short school for Water & Sewage Works Operators at Ga. Tech. Sept. 1947, and printed as bound booklet by Water & Sewage Works.

22. Scope and Value of Water Works Schools. Jour. A.W.W.A., 40, 1005-1027 (1948).

23. The Chemistry of Water Treatment. Part I. Coagulation. Wtr. & Sewage Works., 95, 142 (1948).

24. The Chemistry of Water Treatment. Part II. Softening. Wtr. & Sewage Wks., 95, 211 (1948).

25. The Chemistry of Water Treatment. Part III. Stabilization. Wtr. & Sewage Wks., 95, 369 (1948).

26. Disposal of Softening Plant Wastes. Jour. A.W.W.A. 41, 819-836 (1949).

27. Relation Between Surface Pollution and Public Water Supplies. Engineering Publications. Vol. III, No. 2, Series No. 26, April, 1949 (U. of Fla.).

28. The Fluoridation of Public Water Supplies - Statement of Recommended Policy and Procedure -- AWWA. Presented at annual conference, Chicago, June 1, 1949. Published Jour. A.W.W.A. July (1949).

29. The Chemistry of Water Treatment. Part IV. Determination of pH Values. Wtr. & Sewage Wks., 96, 133 (1949).

30. The Chemistry of Water Treatment. Part V. Some Unusual Water Treatment Problems. Wtr. & Sewage Wks., 96, 325, July (1949).

31. Water Conservation in Florida. Jour. of Fla. Eng. Soc., 1, 4 (1949).

32. Developments in the Water Works Field in 1949. Wtr. & Sewage Wks., 97, 1 (1950).

33. Water Quality and Treatment. A.W.W.A. Manual, 2nd Ed., 1950.

34. Development of Adequate Water Resources for Fringe Areas. Eng. Progress at the U. of Fla., 5, 35 (1951).

35. Fluoridation of Municipal Waters - A Chemist's Evaluation. Public Health Reports, Vol. 67, No. 1, 36, Jan. 1952.

36. Problems of Water Supply and Treatment at Miami, Florida. Wtr. Wks. Eng., Apr. 11 1951.

37. Recalcining Softening Sludge at Miami, Florida. Wtr. Wks. Eng., March, 1951.

38. The Chemist Looks at Fluoridation. Jour. Am. Dent. Assn., 44, 127 (1952).

39. The Philosophy of Supplementary Treatment of Public Water Supplies in the Interest of Group Health. Jour. A.W.W.A., 43, No. 1, 11 (1951).

40. Chemical Character of Florida's Waters--1951. Published as Water Survey and Resea Paper No. 6, November, 1951. State Board of Conservation, Tallahassee, Fla. (A bo

41. Industrial Water Supply in Florida. Economic Leaflets, Vol. II, No. 2, Jan. 1952.

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43. Industrial Water Supply: Unexcelled. The Florida Handbook, 190-192 (1953).

44. Salt Water Intrusion in Florida--1953. Published as Bureau of Water Survey and Research Paper No. 9, May 1953, State Board of Conservation, Tallahassee, Fla. (A book).

45. Status of Training Courses and Certifications in the United States. (Committee Report - a report of Committee G-10, Uniformity of Grading, Registration and Short Courses. Presented on May 13, 1953, at the annual conference, Grand Rapids, Mich. Published.

46. The Water Resources of the South. Editor and Publisher of the SNPA, Golden Anniversary Edition. October 31, 1953.

47. Stay South, Young Man. FLAGS, Guest Editorial, March 1954.

48. Some Facts Concerning Fluoridation. Published by Ga. & S.C. State Boards of Health, each in several thousand copies. (A monograph).

49. The Water Superintendent and Fluoridation. The Municipal South, 15-17, May, 1954.

50. A National Approach to the South's Pollution Problem. Southern Chemical Industry. 24-27, May-June, 1954.

51. A Survey of the South. Southern Issue, American Dyestuff Reporter, Dec. 11, August 30, 1954.

52. The Water Superintendent and Fluoridation. (Reprinted). Mueller Record, 4-8, Aug. 1954.

53. Special Report on Florida's Water Resources in Florida on Parade section of Sept.-Oct. 1954 issue of Industrial Development, pages 22-23.

54. A National View on the South's Pollution Problem. Southern Industrial Wastes Conference. Southern Assn. of Science and Industry. Manufacturing Chemists Assn. and Texas Chemical Council. PROCEEDINGS, M.C.A. 1-7 (1954).

55. Water Requirements in Florida. Eng. Progress at the U. of Fla. Bulletin No. 72, 14, April, 1955.

56. Facts in Refutation of Claims by Opponents of Fluoridation. Jour. Am. Dental Assn., Vol. 50, 655-664, June, 1955.

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CURRICULUM VITAE

WILLIAM C. THOMAS, JR., M. D.

BIRTH: April 7, 1919; Bartow, Georgia

DEGREES: B. S., 1940, University of Florida, Gainesville, Florida
M. D., 1943, Cornell University Medical College, New York, New York

ACADEMIC AND OTHER PROFESSIONAL POSITIONS:

Intern in Medicine, New York Hospital, January, 1944 - October, 1944.

Medical Corps, A. U. S., October, 1944 - October, 1946, with 14 months overseas duty as medical officer 204 General Hospital

Assistant Resident in Medicine, New York Hospital, October, 1946 - June, 1949.

Private practice, Internal Medicine, Gainesville, Florida 1949 - 1954

N. I. H. Research Fellow, Endocrinology and Metabolism, The Johns Hopkins Hospital, 1954 - 1956.

Research Fellow, The Arthritis and Rheumatism Foundation, Endocrinology and Metabolism, The Johns Hopkins Hospital, 1956 - 1957.

Assistant Professor of Medicine and Director, Division of Postgraduate Education, College of Medicine, University of Florida, 1957 - 1960.

Associate Professor of Medicine and Head Endocrine Section, College of Medicine, University of Florida, 1960 - 1963.

Professor of Medicine and Head Endocrine Section, College of Medicine, University of Florida, 1963 - date.

Program Director, Clinical Research Center, College of Medicine, University of Florida, 1962 - date.

Acting Chairman, Department of Medicine, College of Medicine, University of Florida, September, 1968 to date.

PROFESSIONAL SOCIETIES:

American Clinical and Climatological Association
Certified, American Board Internal Medicine
The Endocrine Society
The American Diabetes Association

[illegible]

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[illegible]:

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PUBLICATIONS

William C. Thomas, Jr., M.D.

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40. Tomita, A., and W. C. Thomas, Jr.: Mineralization in vitro of human and animal collagen. (In preparation)

41. Tomita, A., and W. C. Thomas, Jr.: Comparative studies on mineralization in vitro of cartilage matrix and tendon. (In preparation)

42. Connor, T. B., W. C. Thomas, Jr., W. B. Stodghill, and J. E. Howard: Malignant tumors mimicking hyperparathyroidism. (In preparation)

Curriculum Vitae

Gerhard Freund, M.D.

Date of Birth:	April 21, 1926
Birthplace:	Frankfurt/Main, Germany
Citizenship:	U. S. Citizen by Naturalization
Marital Status:	Married, two children
Degrees:	M.D., 1951, J. W. Goethe University, Frankfurt, Germany M.S., 1957, McGill University, (Experimental Medicine)
Internship:	1951-1952, Ottawa Civic Hospital, Ottawa, Canada
Residency (Medicine):	1952-1953, Augustana Hospital, Chicago, Illinois 1953-1955, University of Illinois Research and Education Hospital, Chicago, Illinois
Research Fellowship:	1955-1957, Research Fellow, McGill University, Montreal, Canada (Endocrinology)
Faculty Appointments:	1953-1955, Clinical Instructor of Medicine, University of Illinois College of Medicine, Chicago, Illinois 1957-1960, Clinical Instructor of Medicine, University of Illinois College of Medicine, Chicago, Illinois 1960-1963, Assistant Clinical Professor (Internal Medicine), University of Illinois College of Medicine, Chicago, Illinois 1964 - Assistant Professor of Medicine, Department of Medicine, University of Florida College of Medicine, Gainesville, Florida
State Board Examinations:	1951 - Germany 1955 - Ontario, Canada 1957 - Illinois 1960 - California 1962 - Minnesota Basic Science Examination 1964 - Florida
Board Certification:	1962 - Internal Medicine 1963 - Fellow of The American College of Physicians
Professional Societies:	American College of Physicians American Medical Association Florida Medical Society Alachua County Medical Society

R. P. Vogh

Biographical Sketch

VOGH, RICHARD PHILIP, JR: Superintendent of Water and Sewage Plants, City of Gainesville, Florida, 701 SE Third, Gainesville, Florida.

PERSONAL RECORD: Born May 19, 1921 in Wilmington, North Carolina; married, four children; height 5'7", weight 170 lbs. Health, excellent.

SCHOLASTIC TRAINING: Graduate of Miami Edison Senior High
Associate of Arts degree, University of Florida
Completed Junior year in Engineering College, University of Florida.

EXPERIENCE: 1940-1942, Cooperative student Florida Power and Light Co., Manufactured Gas Division.
1942-1946, Army Air Corps. Overseas duty with China based Fourteenth Air Force as Depot Aircraft Engineering officer. Filled in as required as training, transportation, or utilities officer.
1946 to present - City of Gainesville Utilities
1946-48 Power Plant Operator
1948-50 Chief Operator Water Plant
1950-52 Water Plant Superintendent
1952 - Water and Sewage Plants Superintendent

CERTIFICATION: 1952 - Class "A" Water Operator
1958 - Class "A" Sewage Operator

MEMBERSHIPS: Presbyterian Church
American Water Works Association
Federation of Pollution Control Association
Florida Water and Sewage Works Operators Association -- have held numerous offices.

Riley N. Kinman

Biographical Sketch

KINMAN, RILEY NELSON: Research Associate of Chemistry and Sanitary Science, University of Florida, Gainesville, Florida, 922 NE Third Avenue, Gainesville, Florida.

PERSONAL RECORD: Born January 25, 1936 in Dry Ridge, Kentucky; married, two children; height 6'2", weight 190 lbs. Health, excellent.

SCHOLASTIC TRAINING:

1954-1959	B.S.C.E., University of Kentucky, Lexington, Kentucky.
1961-1962	M.S., University of Cincinnati, Cincinnati, Ohio.
1963-1965	Ph.D., University of Florida, Gainesville, Florida.

EXPERIENCE:

1959-1961	Engineer for the City of Dayton, Ohio.
1961-1962	PHS Trainee, University of Cincinnati.
1962-1963	Engineer for City of Dayton, Ohio.
1963	Registered Professional Engineer, State of Kentucky.
1963-1965	PHS Trainee and Research Associate, University of Florida, Gainesville, Florida.

SOCIETIES AND ORGANIZATIONS:

American Society of Civil Engineers
American Water Works Association
Water Pollution Control Federation
American Chemical Society

PUBLICATIONS: Author of three publications in the field of water disinfection.